A LOOK AT THE SAN FRANCISCO FIRE DEPARTMENT

EARLY DEFIBRILLATION PROGRAM

STRATEGIC MANAGEMENT OF CHANGE

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ABSTRACT

The purpose of this research paper is to examine the San Francisco Fire Department's early defibrillation program and make recommendation to the SFFD that will help our department address the problem of low survival rate from cardiac arrest. Through the use of the descriptive and evaluation research methodology the current status of the early defibrillation program will be assessed and the following questions will be answered:

1. After ten years of the existence, has the early defibrillation program's survival rate for cardiac arrest patients plateaued at a certain percentage?

2. Can modifications or alterations be made to the SFFD early defibrillation program that will improve the survival rate for cardiac arrest patients?

3. Will the merger of the SFFD and the Public Health Department (ALS ambulance) in July of 1998, help increase the survival rate for cardiac arrest patients?

The procedures followed for the research was the usage of a literature review and interviews with SFFD subject matter experts.

The results of the research indicated that yes the survival rate for cardiac arrest had plateaued at 17%. Secondly, the research showed that modifications to the existing program in the form of early CPR awareness, CPR training and public access defibrillators should lead to higher survival rates. The awswer to the third research question was inconclusive because no data was factly available to support that the merger has led to an increased survival rate

Implementation of the eight recommendations ranging from comprehensive citizen CPR education program to working closely with the EMS Agency and San Francisco' s governing authoritiess so that public access defibrillation becomes a really soon,

TABLE OF CONTENT

INTRODUCTION

In an effort to better serve the public, fire service agencies across the country have increased their role in providing emergency medical services (EMS). Annually, 1.5 million people die from cardiac arrest in this country. Initially cardiopulmonary resuscitation (CPR), coupled with rapid transport by ambulance to a hospital was the only way fire service agencies could reduce the amount of deaths caused by cardiac arrest. Unfortunately the survival rate (defined as a patient who is discharged alive from the hospital) for victims of cardiac arrest in San Francisco, prior to 1988 was 3 percent.

The medical community and fire services agencies have jointly looked for ways to address the problem of an extremely low chance of survival from cardiac arrest. In 1988, the San Francisco Fire Department (SFFD) and the Department of Public Health (which provides advance life support ambulance service for San Francisco) decided that the forty-one engine companies of the fire department would be equipped with semi-automatic defibrillators in an effort to address the problem of low survival from cardiac arrest. The SFFD called this early defibrillation program project Rapid Zap.

In 1990, a review of SFFD records indicated that the survival rate for patients of cardiac arrest had increased to 11 percent. This improvement of the survival rate was hopeful, yet until we can save almost every cardiac arrest patient that meets the criteria for the use of the semi-automatic defibrillator (those in a shockable rhythm- ventricular fibrillation(VF) or ventricular tachycardia(VT), which (Ruskin, 1988) indicated that approximately 30 percent of all cardiac patients are found in a shockable rhythm, therefore improvements must continue to be made on the program.

The purpose of this research paper is to examine the early defibrillation program and make recommendation to the SFFD that will help our department move closer to the elimination of the problem of a low survival rate from cardiac arrest. Through the use of the descriptive and evaluation research methodology the current status of the early defibrillation program will be assessed and the following questions will be answered:

1. After ten years of the existence, has the early defibrillation program's survival rate for cardiac arrest patients plateaued at a certain percentage?

2. Can modifications or alterations be made to the SFFD early defibrillation program that will improve the survival rate for cardiac arrest patients?

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BACKGROUND AND SIGNIFICANCE

Fire service agencies have known that CPR can be a life-saving technique if administered quickly and properly for some time. Yet, CPR alone in most cases has had a dismal success rate. "Without the availability of early defibrillation, less than 4 percent of cardiac arrest patients survive". (Mercer, 1993, pg. 36) The reason for this is because, while CPR can help sustain life by prolonging ventricular fibrillation and ventricular tachycardia, it cannot convert these abnormal rhythms back to a profusing rhythm as defibrillation can. The quickest and most effective means of returning the heart to a normal profusing rhythm is by administering a defibrillatory shock.

Prior to the early 1980s, defibrillation could only be performed by doctors in hospitals or by paramedics using manual defibrillators with shocking paddles. This required thorough training in the recognition of cardiac rhythms. (Cunningham, 1995) indicated that "automatic external defibrillators (AEDs), including automatic and semi-automatic external defibrillators were developed in 1979". These AEDs, use an internal processing unit that analyzes the patient's heart rhythm, allowing defibrillation only with ventricular fibrillation (VF) or pulseless ventricular tachycardia (VT). These new defibrillators performed the heart rhythm analysis, and they opened the door for emergency medical technicians (EMTs) to administer life-saving defibrillatory shocks.

A patient of cardiac arrest has only between 8 to 12 minutes in which the heart remains in a shockable rhythm, and they have any chance of survival. The response time for ambulances with paramedics in San Francisco prior to project Rapid Zap was 7 1/2 minutes. The mission or goal of the SFFD Emergency Medical Services Division is to provide the most effective and efficient medical care for San Francisco. The significance of project Rapid Zap was that once the SFFD early defibrillation program was on-line the response time of one of our 41 engine companies, with EMT and defibrillator, on board was reduced to 3 1/2 minutes. In the 1990 review of the SFFD, EMS records attributed the increase in the survival rate of cardiac arrest patients to the reduction in response time for defibrillation intervention.

The early defibrillation program is consistent with the SFFD's and EMS Division missions. Conducting a research study now, some ten years after the inception of project Rapid Zap, relates to the Strategic Management of Change course this researcher recently completed. In light of the recent merger that brought the Public Health EMS

Division, with its 172 paramedics into the SFFD, it is appropriate that we monitor and manage this change so that we might ensure an increase in the survival rate of cardiac arrest patients.

LITERATURE REVIEW

The literature that was reviewed in an attempt to answer my research questions included books, periodicals, journals, National Fire Academy research papers, and personal interviews with subject matter experts within the SFFD, EMS Division.

(Newman, 1997, pg. S-5) indicated, On an average day in America, 1,000 adults die from sudden cardiac arrest (SCA)". Experts believe that at least a third of these people could be saved if the maximum time to defibrillation were in the range of five to seven minutes. But many will have to wait too long for the defibrillator to arrive. Others will be buried long before their communities even have defibrillators. Science and technology have given us the means to save more lives. Why, then, do so few survive?

(Santin, 1994, pg. 8) From the first days of citizen CPR, strategies for improving emergency medical services outcomes in cardiac arrest have evolved, based largely on the "chain of survival" concept. In short, this theory holds that surviving out-of-hospital arrest is contingent on five elements: early EMS access; early CPR; early defibrillation; early advanced cardiac life support (ACLS), and early definitive cardiac care. Without the inclusion of each and every factor in a timely manner, the survival equation crumbles.

The (American Heart Association, 1992) recommendations point out “while all links must have strength, rapid defibrillation is the most important single factor in determining survival.”

This idea is further supported by Newman (1997) when referring to the chain of survival and states, “That early defibrillation the most critical link in this chain is now considered a central tenet of EMS.”

An example that further reinforces this is a Canadian study that stated that the Ontario Ministry reported, ”a mean 13.1 minutes from time of patient collapse to application of the defibrillator simply is not early. Not surprisingly, their ultimate survival rate of 2.5 percent was amongst Canada’s lowest.” (Santin, 1994, pg. 7) The same article by Santin (1994) referred to the Hamilton Fire Department which equipped its firefighters with defibrillators. The firefighters cut the mean time to defibrillation to 5.5 minutes, which resulted in an actual improvement in survival rate from 2.7 to 5.7 percent.

Most expert agree that defibrillation must be delivered within 8 to 12 minutes. “ most studies have shown that in order for defibrillation to have significant impact on survival, that patient needs to be defibrillated within 8 to 10 minutes.” (Clinchy, 1993, pg. 34)

Cummins (1989, pg. 1271) stated, “with every minute that passes there is a steady decline (from 7% to 10% per minute) in the probability that patients in inventricular fibrillation will not survive even if they are defibrillated. Defibrillation delayed much longer than 10 to 12 minutes yields a virtual zero probability of survival.”

The poor prognosis for patients who suffer sudden cardiac death outside the hospital has been documented repeatedly. Much of the morbidity from outside-

of-hospital cardiac arrest results from the fact that more than a few minutes of global cerebral ischemia results in significant neurologic disability. This poor tolerance of the brain to deprivation of blood flow is widely perceived as an insurmountable barrier to improving survival after out-of-hospital resuscitations. (Callaway, 1997, pg. 47)

Early and effective CPR is critical in the chain of survival because it can buy time for the patient. "The faster CPR is started - the better the chance of survival. Not only does the brain continue to be profused with oxygen and blood, also the heart is kept in a "fibrillating state" longer - thereby giving emergency personnel time to arrive on scene and defibrillate the patient." (Gallagher, 1995, pg. 1923)

Some researchers have been unable to demonstrate a clear relationship between CPR effectiveness and outcome, most notably those in Seattle, Washington. A study by Gallagher in New York City looked a data from 2071 cardiac arrest and found 662 patients who had received CPR.

Those individuals who received bystander CPR had a survival rate 2.9% (19/662) vs. a survival of 0.8% (11/1405) for those who did not receive CPR. Of the 32% of the individuals(662/2067) on whom bystander CPR was attempted, 46% (305/662) had it performed effectively. Of these, 4.6% (14/305) survived. Among those patients with ineffective CPR, 29% (103/357) patients with effective compressions and ineffective ventilation for a 2.0% survival.

Seven percent (26/357) received ineffective compressions and effective ventilations for a 0.0% survival. In the remaining 64% of cases (229/357), neither compressions nor ventilations were effective for a survival of 0,6%. Of those with

ineffective CPR, 1.4% (5/357) survived (95% CI for an absolute difference of 3.2% in survival between effective and ineffective CPR. (Gallagher, 1995, pg. 1923)

The author of the New York study concluded that the association between bystander CPR and survival rate of out-of-hospital cardiac arrest patients appears to be determined by CPR quality. Effective CPR is independently associated with quantitatively and statistically significant increased survival rates.

In Seattle, where survival rates are high, investigators have been unable to detect an improvement in survival associated with effective performance of CPR. The author suggest that this finding may be attributed to the rapid response of prehospital personnel. The findings support this speculation. In New York City, where the interval from collapse to arrival of prehospital personnel is substantially longer than in Seattle, he found that after adjustment for witness status, initial rhythm, interval from collapse to CPR, and interval from collapse to ALS effective CPR was independently associated with roughly three-fold to four-fold proportionate increase in survival when compared with ineffective CPR.

Gallagher, 1995, pg. 1923)

Valenzuela raised another important issue by stating, “that emergency vehicle response times were not important, rather time from collapse to intervention was the key issue. The mean collapse-to-CPR interval was 3.5 minutes shorter in survivors. The collapse-to-defibrillation interval also was significantly shorter (2.1 minutes) in survivors than nonsurvivors. Bystander CPR was associated with better survival”. (Valenzuela, 1993, pg. 1680)

The Valenzuela study contain information related to my third research question.

"Interestingly, basic life support (BLS) and advanced life support (ALS response intervals did not differ significantly between survivors and nonsurvivors in our population. In contrast, the intervals from collapse to CPR and from collapse to defibrillation were both significantly shorter in survivors than in nonsurvivors". (Valenzuela, 1993, pg. 38)

At the Public Access Defibrillation Conference in Washington, D. C., in April of 1997, Ostrow reported, "the American Heart Association as well as manufacturers' representatives in attendance expressed support for immediate and large-scale deployment of AED's, as well as for other products that bring defibrillation and CPR training directly to the consumer". (Ostrow, 1997, pg. 42) CPR Prompt, for example, a CPR home learning system, already is being sold in Wal-MART and other mass merchandising outlets by company founder Steve Lindseth, who also introduced consumers to the tympartic thermometer and he Interplak electric toothbrush.

This literature review makes it clear that the sooner some form of intervention (CPR or defibrillation) takes place, the greater the chance for survival becomes overall. Most strategies call for emergency personnel to intervene in cardiac arrest cases. Recently, strategies are involving the lay public as potential first responders in the event of cardiac arrest.

The American Heart Association is the leader in the push for public access defibrillation. In October of 1993, they appointed a task force on automatic external defibrillation.

AHA Broad of Directors issued the following statement.

Early bystander cardiopulmonary resuscitation (CPR) and rapid defibrillation are the two major contributors to survival of adult victims of sudden cardiac arrest.

> The AHA supports efforts to provide prompt defibrillation to victims of cardiac arrest. Automatic external defibrillation is one of the most promising methods for achieving rapid defibrillation. In public access defibrillation, the technology of defibrillation and training in its use are accessible to the community. The AHA believes that this is the next step in strengthening the chain of survival. Public access defibrillation will involve considerable societal change and will succeed only through the strong efforts of the AHA and others with a commitment to improving emergency cardiac care. (Weisfeldt, 1995, pg. 92)

The personal interviews I conducted with SFFD, EMS subject matter experts revealed that their was a strong consensus that early CPR was the critical component area of the chain of survival that had to be improved. The experts felt that availability of CPR training was an absolute necessity, but more importantly awareness components in CPR training that included:

1. The linkage between CPR and Defibrillation.
2. That there has been no documented case of anyone catching a communicable disease from CPR.

The Captain of In-Service Training mentioned a new program by Sharon McComb that had been introduced in three pilot schools called, “CPR in the Schools”. The subject matter experts also suggested that Parking Control Officers and Police Officers should receive extensive training in CPR.

The opening statement by Newman influenced this writer on how important this research topic could be. Pollack stated, “Probably the most important reason for EMS and first responder agencies to collect and manage data, is to ensure a high level of

patient care." (Pollack, 1992, pg. 76) This statement and the numerous findings and observations of the literature review, as well as insights from the SFFD, EMS subject matter experts, have guided and influenced this writer in the importance of periodic in-depth studies of our systems and procedures. This writer is now confident this research will benefit the department, and more importantly, the people we are sworn to serve.

PROCEDURES

I began my research as a student of the National Fire Academy in October, 1997. The research methods used were the evaluative and descriptive methodologies. The National Fire Academy, Learning Resource Center (LRC) enabled this researcher to rapidly acquire various sources on the subject of defibrillation through a computer search. The computer search identified trade journal articles, periodicals, and LRC search papers on related subject matter material. The University of California, San Francisco and San Francisco General Hospital libraries were searched because both libraries contain an extensive amount of medical and emergency medical response journals and periodicals. The evaluation methodology was utilized to determine which articles and research papers were relevant to my research topic.

Following a thorough review of all my material on defibrillation, I placed a telephone call to Assistant Chief, Richard Shortall who heads the SFFD, EMS Division. Chief Shortall directed this researcher to set-up an appointment with Dr. Eric Issacs, the Assistant Medical Director for the SFFD, who is in charge of the early defibrillation program. Dr. Issacs shared additional material on the latest developments in

defibrillation and expressed his views on improvement in the area of defibrillation. Dr. Issacs arranged meetings with:

1. Captain Goodin, Project Manager for Prehospital Care Records (PCR) Data Entry.
2. Section Chief, Jane Smith, Director of the EMS Academy.
3. Section Chief, Anthony Smerdel, EMS Operation Chief.
4. Captain Glenn Ortiz-Schuldts responsible for Medical In-Service Training.
5. The Quality Improvement Staff comprised of Captain Nancy Nowicki, Lt. Brady, and Firefighters Masterson, and Sobozinsky (they all are paramedics as well).

This researcher interviewed each of these individuals. They shared how their particular assignment related to the early defibrillation program. Captain Goodin explained how cardiac arrest data includes patient age, gender, presenting rhythm, roll time, whether the cardiac was witnessed, whether the patient received bystander CPR. Return of spontaneous circulation (ROSC) and outcomes are compiled in spreadsheet format and used to assemble system reports, which are then provided to the EMS Agency on a monthly basis. With Captain Goodin's assistance, this researcher was able to extract the information necessary for the results section of this project.

The Quality Improvement (QI) staff reviews all cardiac arrest calls for which the SFFD initiates treatment. In addition, they initiate investigations of other EMS calls in which the Department provides BLS services. QI reports are submitted every six months to the EMS Agency as well as a detailed report of Medical Services activities at the close of each fiscal year. They also file Unusual Occurrence reports if there is a departure from protocol or a possible malfunction of the AED's. These Unusual Occurrence reports must

be explained and rectified at the EMS Agency. Disciplinary action can results if the EMS Agency feels it is warranted.

The QI also obtains follow-up information for each cardiac arrest patient who is not pronounced in the field. This is obtained by reviewing the Paramedic ALS patient care report, and by obtaining Emergency Department and receiving hospital information. With the assistance of the EMS Agency and Receiving Hospital Liaisons, a mechanism has been instituted to allow the QI staff to determine the outcome and neurological status of cardiac arrest patients SFFD has cared for. The Quality Improvement Staff is the key link in sharing their finding so that training can be improved and system adjustments are made to improve service.

All of the above mentioned individuals submitted suggestions to improve the early defibrillation program. (See appendix)

Limitations

Not being able to interview all the paramedics who shocked patients.

Definition of Terms

Cardiopulmonary resuscitation (CPR) - A procedure designed to restore normal breathing after cardiac arrest that includes the clearance of the air passages to the lungs and heart massage by the exertion of pressure on the chest.

Fibrillation - very rapid irregular contractions of the muscle fibers of the heart resulting in a lack of synchronism between heartbeat and pulse.

Defibrillation - the process of passing a direct current electrical charge through the heart in order to bring pulseless ventricular tachycardia or ventricular fibrillation to an end and return the heart to a more normal rhythm.

Ventricular Fibrillation - rapid discharges of many electrical foci in the heart resulting in a trembling of the heart muscle, resulting in no cardiac output.

Ventricular Tachycardia - a cardiac dysrhythmia that originates from a single abnormal place in the ventricle and may result in a patient who is in cardiopulmonary arrest and pulseless.

Automated External Defibrillator - A generic term that applies to automatic or semi-automatic defibrillator. This instrument determines that the patient is in a dysrhythmia appropriate to defibrillation

Dysrhythmia - An abnormal heart rhythm. Dysrhythmias present in over 60% of sudden cardiac deaths.

Cerebral Ischemia - referring to the brain, localized tissue vitality reduced due to obstruction or decrease of the inflow of arterial blood.

Neurologic Disability - damage to the nervous system.

Profusing Rhythm - pouring forth liberally, an abundant flow of blood carrying oxygen sent out from the heart.

EMS Agency - Department of Public Health review board, empowered by the State of California. Currently headed by Dr. Thomas Brown, Administrator, Abbey Yant, 2 nurses and 3 paramedics.

Roll Time - Time from when the dispatch is received by responders to on scene arrival.

Asystole - Flatline with no electrical activity.

Agonal Rhythm - referred to as the dying rhythm, wavy with an occasional upbeat, generally during CPR

Endotracheal Intubation - the introduction of a hollow tube fitted through the trachea to the lungs to facilitate oxygen to the lungs.

RESULTS

The purpose of this research paper was to examine the SFFD Early Defibrillation Program and more specifically to answer the three questions referred to in the Introduction section of this paper.

Review of the patient care records for fiscal year (1996-1997) indicated 456 patients in cardiac arrest were initially cared for by the SFFD with attachment of the semi-automatic external defibrillator(SAED). There were no patients who met criteria for attachment of the SAED who did not have the defibrillator attached. There were six instances of possible malfunction of the Zoll SAED for which Unusual Occurrence reports were filed.

Of the 456 cardiac arrest patients, 22 patients met exclusion criteria and technically should not have had the SAED attached. Of these 22 patients, 12 were determined rigor mortis, 4 had evidence of traumatic injury to the core and 6 patients had Do-Not-Resuscitate orders presented after attachment of the SAED. Of course merely attaching the SAED to these patients caused no harm, and is considered to be conservative in stances in which death is not easily confirmed.

1. Presenting Rhythms - Of the 456 patients presenting in cardiac arrest, 229 (50%) were found to be asystole, 112 patients (24%) were found to be inventricular

fibrillation(VF); 59 patients (13%) were found to have pulseless electrical activity (PEA) ; 49 patients (11%) presented with an agonal rhythm,
and 7 patients (2%) had initial rhythms that could not be determined due to equipment (tape or module) malfunction.

2. Age - The range of ages for patients suffering cardiac arrest was between 17 years and 99 years. The average was 66 years and the median age was 70 years. Patients presenting with an initial rhythm of ventricular fibrillation ranged in age from 35 to 95 years.

3. Gender - 287 patients (63%) presenting in cardiac arrest were male, while the remaining 169 patients (37%0 were female. Of patients initially demonstrating ventricular fibrillation, 77 (69%) were male and 35 (31%) were female.

4. Witnessed Arrest - 196 patients (43%) suffered a bystander witnessed cardiac arrest. 256 patients (56%) suffered unwitnessed cardiac arrest. Four patients suffered a cardiac arrest witnessed by EMS providers. Of the patients found to have initial rhythms of ventricular fibrillation 81% were witnessed while 19% were unwitnessed.

5. Bystander CPR - Of the 196 witnessed arrest, 66 (33%) had an attempt at bystander CPR. Patients who suffer unwitnessed arrest (236) are not considered to have had an attempt at bystander CPR. Thus, only 66 out 456 patients received bystander CPR. This results in an overall system bystander CPR rate of 14% which is extremely low.

6. Ventricular Fibrillation - During the past year 112 patients (25% of all cardiac arrest) were found to have an initial rhythm of ventricular fibrillation. Of these patients, 19 **(17%)** survived to hospital discharge. An additional 19 patients whose initial rhythm were

not ventricular fibrillation developed ventricular defibrillation during the course of their resuscitation and were subsequently defibrillated. Only 1 of these 19 patients survived. This patient was discharged home after this cardiac arrest which occurred as a result of a heroin overdose; a non-cardiac event.

Now, I will address the questions I posed in my Introduction. First, after ten years in existence has the early defibrillation program's survival rate for cardiac arrest victims plateaued at a certain percentage? A review of the last four fiscal years showed that the survival rate for sudden cardiac arrest has indeed plateaued at **17%.** Statistics show the rates at: 1993-1994 a rate of 17%; 1994-1995 at a rate of 16%; 1995-1996 at a rate of 17%; and again the statistics showed fiscal 1996-1997 resulted in a survival rate of 17%.

Second, can modifications or alterations be made to the SFFD early defibrillation program that will improve the survival rate for cardiac arrest patients? The answer is Yes. The literature review indicated that defibrillators are important to shock the heart into a normal profusing rhythm, but without bystander CPR which can buy time for the arriving defibrillation unit, the defibrillator effectiveness will be minimal unless that heart has been kept in a strong fibrillating state. The SFFD subject matter experts unanimously felt that early CPR, CPR awareness and CPR training for the public were the weak links in the survival chain. The literature and the subject matter experts are also in agreement that public access defibrillators will be a welcome modification to any early defibrillation program (this researcher will elaborate further in the discussion section).

Third, will the merger of the SFFD and the Public Health Department (ALS ambulance) in July of 1998, help increase the survival rate for cardiac arrest patients? The answer to this third question is inconclusive. This researcher found no evidence in

the literature that proves that ACLS provided by the Paramedics did in fact increase the rate of survival. The literature points out that ACLS is a link in the survival chain , but fails to describe the actual impact. The Assistant Medical Director, Eric Issacs pointed out that ACLS paramedics perform endotracheal intubation, and the administration of cardiac medication to maintain the heart in a normal rhythm, after it has been maintained in a fibrillating state by CPR, and defibrillated to a normal rhythm, thus giving the patient the greatest chance of survival. However Dr. Issacs agreed that in the absence of data supporting this contention, it remains conjecture.

DISCUSSION

During the past year, 7% of all cardiac arrest patients survived and 17% of all patients whose initial rhythm was ventricular fibrillation survived. There has been no significant change in survival from the pervious year. In fact, the survival rate for V-fib patients has been roughly 17% for four years.

The management of the Early Defibrillation Program has been internal within the San Francisco Fire Department since July, 1994. This researcher compared the V-fib survival rate for the first and second year of the program under SFFD management with the results of the program while under the direction of the University of California's Center for Prehospital Research and Training (CPRT), the managers for the first eight years of the program. No significant difference in survival was found. This is both good and bad news.

On the positive side, there has been no harm to the cardiac arrest patients by transferring the responsibility for management of the defibrillation program from a healthcare and university affiliated organization (CPRT) to the SFFD. In addition, since 1994, quality markers indicate that the firefighters have improved their clinical performance in treating cardiac arrest patients, although there has been no measurable improvement in the survival rate.

One might reasonably question why after a significant amount of training and quality management procedures there has not been an improvement in the number of patients who survive out-of-hospital cardiac arrest. The SFFD subject matter experts point out a number of reasons. Most important among these is the finding for the second year in a row that the rate of bystander CPR performed for patients of sudden cardiac arrest in San Francisco is a dismal 14%. This means that only 14 of every 100 patients found in cardiac arrest receive some attempt at CPR prior to EMS arrival.

The emergency cardiac care literature suggests that unless all five links in the chain are intact, survival from out-of-hospital cardiac arrest will be poor. The SFFD data suggests that four of the five links in the chain are intact and strong. It appears that 911 is accessed quickly and appropriately for patients found to be in cardiac arrest. Firefighters respond and perform defibrillation for patients with V-fib within 5 minutes. Paramedics arrive soon after the firefighters and begin (ACLS). Lastly, the patients are rapidly transported to a San Francisco receiving hospital for definitive cardiac care. However, because 86% of our cardiac arrest patients do not receive bystander CPR, the chain of survival is broken, and optimal outcome from prehospital cardiac arrest cannot be expected.

Thus, the only way to improve our survival rate from cardiac arrest is to increase the number of patients in V-fib when our firefighters/paramedics arrive. The only means of doing this is to have more patients receive bystander CPR and have the firefighters/paramedics arrive as early as possible following cardiac arrest.

The subject matter experts also pointed out the following reasons why the rate of bystander CPR is so low In San Francisco :

1. the lack of a coordinated aggressive citizen CPR campaign
2. a fear of close contact with others who are "different" in San Francisco's multicultural, multi-ethnic population.
3. the fear of contracting a communicable disease such as HIV or Hepatitis.

Other communities have been successful in improving the rate of bystander CPR, most notably Seattle, Washington, which reports the highest survival rate for patients with V-fib cardiac arrest in the world (35%). It is therefore not surprising that in Seattle more than 50% of the cardiac arrest patients receive bystander CPR. While one might argue that Seattle's higher rate of CPR is attainable because its population is less diverse, has a lower prevalence of HIV disease, homelessness, and substance abuse, it is clear that Seattle has been extremely effective in convincing its residents of the importance of learning and performing CPR.

The subject matter experts point out that it is possible that a number of the patients who experience cardiac arrest in San Francisco are not suffering a "primary cardiac event" (a heart attack). Early defibrillation programs were to save lives of patients experiencing a sudden decrease in blood to the heart, that is, cardiac ischemia or heart attack. When bloodflow to the heart's conduction system decreases, the heart muscle

may fibrillate. Patients who are dying are less likely to experience ventricular fibrillation. For example, a patient with terminal HIV disease, a drug overdose, or pneumonia may ultimately suffer a heart attack, but this is not due to a sudden decrease in blood flow to the heart. It is not expected that these patients' hearts will fibrillate and therefore they will not benefit from early defibrillation. But, unless it can be determined that their cardiac arrest resulted from another medical problem, the patient is counted as a cardiac arrest patient in the early defibrillation program. This may be inappropriately lowering the reporting survival rate for cardiac arrest in San Francisco.

If we were better able to identify patients who have suffered cardiac arrest due to non-cardiac causes like HIV or drug overdose, we might find that by not counting these patients as true "early defib" cases our survival rate for V-fib might approach Seattle's once we have a better CPR program in place.

Lastly, this researcher would like to mention that the SFFD is starting to initiate a discussion with the EMS Agency on "Public Access Defibrillation". With availability of compact, inexpensive, simple to operate defibrillators, the prospect of training additional members of our community to recognize and begin treatment of cardiac arrest should be supported and hopefully impact the survival rate of sudden cardiac arrest in a positive manner.

RECOMMENDATIONS

The survival rate for sudden cardiac arrest has indeed plateaued at 17%. Yet, this researcher feels that for the most part the Early Defibrillation Program is performing admirably. Only in the area of early CPR can modifications potentially lead to a significant increase in the survival rate for cardiac arrest. This researchers recommendations are supported by the literature and strongly influenced by both the literature and subject matter experts. This researcher feels that the implementation of the recommendations can be justified in the budgetary process and corporate sponsorship could be sought to supplement any shortfall in budget allocations. The following recommendations are positive change that should lead to improved survival rates for sudden cardiac arrest:

- Recognize the need for a comprehensive citizen CPR education program and undertake steps to secure adequate funding for this program.
- Expand the "CPR in the Schools" program. The SFFD could collaborate with Sharon McComb, who developed the CPR school curriculum. A proposal could be made to Board of Education, with the assistance of the EMS Agency for mandatory CPR class in high school.
- The SFFD, EMS Division will assist the Fire Commission in drafting a recommendation to the Department of Parking and Traffic requiring that all parking enforcement officers receive mandatory CPR training.
- The SFFD, EMS Division will assist the Fire Commission to work with the Police Commission to improve the CPR training and performance of police officers in emergency medical situations.

- Immediately develop a 911 dispatch-assisted telephone CPR program modeled after Seattle's system. Half of Seattle's CPR interventions begin after the 911 dispatcher instructed the caller how to perform CPR.
- Develop a CPR training curriculum to be offered to San Francisco corporations and businesses.
- Consider the merits of teaching "chest compressions only" CPR and placing low-cost ventilation face-masks that can be made available throughout the city (perhaps in phone booths). This might make bystander CPR more likely with people fearful of communicable diseases.
- Work closely with the EMS Agency and San Francisco's governing authorities to see that "Public Access Defibrillation" becomes a reality soon.

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APPENDIX

SAN FRANCISCO FIRE DEPARTMENT
EARLY DEFIBRILLATION PROGRAM

Introduction

Prior to the Early Defibrillation Program started in 1987 the survival rate of victims of sudden cardiac arrest was 3%. In 1990 a review of SFFD records indicated that the survival rate for sudden cardiac arrest had increased to 11%.

The reasons for the increase in the survival rate were mostly attributed to the availability of 41 engine companies being equipped with Automatic External Defibrillators (AED'S).

After researching the latest EMS data for fiscal year 1996-1997 the survival rate for sudden cardiac arrest is now 17%. There has been no significant change in survival from the previous year (fiscal year 1995-1996). In fact, the survival rate for V-fib patients has leveled off at roughly 17% for the past five fiscal years.

Now that we are certain that the rate of survival for sudden cardiac arrest has plateaued at 17% I m asking your participation in this personal interview to solicit your thoughts on how we can enhance or modify the current Early Defibrillation Program so that survival rates will continue to increase to new heights.

After our interview can you please write down any suggestions for improvement on the back of this form. Sign this form with your position and return it to: Fred Sanchez, Battalion Six.